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WIND AND RADIATION

By W. J. HUMPHREYS

[Washington, D. C., December 1938]

Naturally, one might suppose that, in general, the radiative loss of heat by the surface of the earth and lower air on clear nights must be the same whatever the wind, calm to gale. It is true that the perviousness of the air to all radiation, ultraviolet, visible, and ultrared, is the same regardless of its motion. Therefore, if everything else were the same, the losses of heat would be equal in the two cases under consideration; but they are not the same, for the temperatures of the surface and of the lower air are affected by the strength of the wind. Where the air is calm the supply of heat to the cooling surface, apart from that conducted up from below, comes from only a very thin layer of the superjacent air, whereas on windy nights it comes, owing to turbulence, from a much deeper layer of this air. Hence, from that cause alone, the surface would be warmer on a windy night than it would have been if the air had been calm. There is also another effect of the wind to take into account that still further increases this temperature difference, namely, the complete mixing of the air of the turbulent layer, by which it is brought to a common potential temperature—its lapse rate made adiabatic instead of being left subadiabatic—and the surface air thus brought to a higher temperature than it would have if calm.

Obviously, then, the surface of the earth and the adjacent air must be, and they are, colder during calm nights than on windy nights. But the loss of heat by radiation from the surface of the earth (practically a full radiator) varies closely as the fourth power of its absolute temperature. Hence, in general, on clear nights the earth radiates a greater quantity of heat when there is a strong wind than it does when the air is calm, but does not come to as low a temperature.

MINIMUM TEMPERATURES DURING SPRING AND AUTUMN AT LINCOLN, NORTH PLATTE, AND SCOTTSBLUFF, NEBR.

By HARRY E. HOY

[University of Illinois, Urbana, Ill., June 1938]

INTRODUCTION

The purpose of this study[1] is to determine the minimum temperatures during the transition periods of spring and autumn at three selected stations in Nebraska. The latest date of freezing temperature ever recorded at Lincoln is May 15 (1907); but the fact that a killing frost has never occurred after this date is not evidence that one never will. The writer, by a detailed study of the 39 or more minimum temperatures for each date, has attempted to determine what the probability of a killing frost is for each day, from reasonable frost-certain to reasonable frost-free dates during spring, and from frost-free to frost-certain dates in autumn.

It is generally known that killing frosts occur on the majority of March days in Nebraska. As spring progresses the occurrences of freezing temperatures become less frequent, so that by June 1, the temperature rarely falls below 32° F. The three stations chosen are representative of the eastern, central, and western parts of the State. Since altitude is a more important modifier of growing season in Nebraska than latitude, an east-west line of stations was believed more desirable than a north-south line. The stations have kept continuous records for periods of 39 to 45 years. The three stations are about equally separated from each other by both altitude and latitude. Scottsbluff at altitude 3,888 feet is the northernmost, latitude 41°50′ N. North Platte, altitude 2,821, is at latitude 41°10′; Lincoln, altitude 1,189, is located at latitude 40°41′. Scottsbluff experiences temperatures and amounts of precipitation which are about the lowest in the State; North Platte's are slightly below the average; at Lincoln they are slightly below the State maximum.

A killing frost is interpreted in this paper to mean a temperature of 32° F. or below, since in a statistical study it is felt that an objective definition of killing frost is more desirable for comparing conditions at different stations and at different times. This results occasionally in small differences between the dates of first and last killing frosts published by the United States Weather Bureau and the dates used in this study. The determination of a killing frost using the presence of frost crystals with freezing destruction to certain plants as indicators is no doubt of more practical importance to growers than is a temperature of 32° F. However, the unavoidable subjective element where several different observers report with different plants as indicators and at different times in the season, although perfectly defensible from a practical point of view, might be a bit indefinite in a statistical paper such as this. Both definitions are recognized as acceptable. Therefore, "freezing temperature" and "killing frost" will be terms used synonymously hereafter in this paper.

[1] See also Earl E. Lackey: Variability Isocrymal Maps for the Great Plains. MO. WEA. REV. 64: 70-76, March 1936.